

Nordic/Baltic Regional ESTH Hub e-Letter

Welcome to the latest [e-Letter](#), our *unclassified* electronic publication sharing regional information, news and events. We encourage you to visit the websites of our Embassies throughout the Hub. Feel free to disseminate to your contacts. At the very end of the e-Letter you will find our featured story, offering background on Carbon Capture and Sequestration (CCS).

Enjoy the read!
Ed Canuel
Bo Gregersen
Adam Bille

AROUND THE REGION.....

DENMARK

Ambassador Fulton Opens Fourth Green Partnership for Growth Conference.

On October 10th Ambassador Fulton and the U.S. Embassy in Copenhagen, together with the Confederation of Danish Industries (DI) and AmCham Denmark held a Green Partnerships for Growth (GPG) conference hosted by DONG Energy. U.S. Ambassador Laurie S. Fulton spoke about the GPG's background, the U.S. *Blueprint for a Secure Energy Future* and the many green U.S. government initiatives. This session was the first follow-up to the May 31st launch of GPG by U.S. Secretary of State Hillary Clinton and Danish Prime Minister Helle Thorning-Schmidt. Read more [here](#) (Picture: Ambassador Fulton with Danish Minister for Climate & Energy Martin Lidegaard. www.amcham.dk)

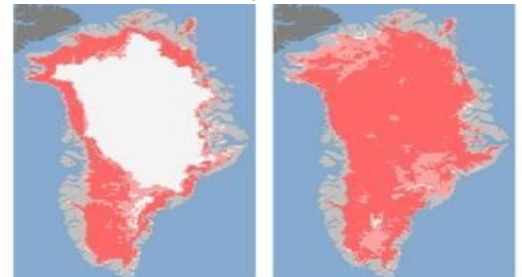


U.S. Offshore Wind Farm to use Danish Know-how. The Danish company Ramboll is leading the team of consultants that is designing the foundations for America's first offshore wind farm--the Cape Wind Offshore Wind Farm, situated off Cape Cod on the U.S. east coast. Read more [here](#).

Copenhagen Wins European Green Capital 2014. Of fourteen cities competing, three finalists - Copenhagen, Bristol and Frankfurt - presented their visions, action plans and communication strategies to the jury. The jury assessed the cities' overall environmental commitment, vision and enthusiasm. Read more [here](#).

Arctic ice shatters previous records

The National Snow and Ice Data Center reported that Arctic sea ice fell to the lowest extent in the satellite record. For several days in July, Greenland's surface ice cover melted over a larger area than at any other time in more than 30 years of satellite observations. Read more [here](#) and [here](#). (Picture: The extent of surface melt over Greenland's ice sheet on July 8, left, and July 12, right. www.nasa.gov)



ESTONIA

Estonian Government Reforms Regulations on Industrial Pollution. Estonian Minister of environment Keit Pentus introduced legislative initiative to reduce industrial pollution. The draft Industrial Pollution Act will enact standards that will be applied to enterprises operating in major industry sectors. Read more [here](#).

Estonia Gets First Nature Protection Development Plan Ever. The Estonian government approved of the nature protection development plan through 2020, which provides the guidelines for directing Estonian nature protection at state levels. Read more [here](#).

FINLAND

National Biogas Network to be Built in Finland. The equity investment company Taaleritehdas is commissioning the construction of Finland's first national network of biogas facilities. Over the course of the next two years, 5-7 biogas facilities will be built, providing a solution for municipalities' biodegradable waste management. Read more [here](#).

Picosun and Singaporean Electronics Institute Begin Cooperation. The atomic layer deposition (ALD) equipment manufacturer Picosun and the Singapore-based Institute of Microelectronics announced a partnership to develop advanced coating techniques for electronics and solar energy products. Read more [here](#).

GERMANY

E.ON Starts Construction of Power-to-gas Pilot Plant. From 2013 onwards the power-to-gas plant will handle excess power that is generated by wind farms and cannot be fed into the power grid. By storing the excess power, wind farms, which would otherwise be shut down for a while to avoid bottlenecks in the power grid, can continue to generate power. Read more [here](#).

German Renewables Fee Rises 47% The expected 2013 renewable energy surcharge will increase 47% from 4.72 to 6.92 U.S. cents as consumers pay for funding renewable energy via government subsidies. Electricity cost for an average household will increase by \$77 per year. The total subsidy next year will amount to about \$26.71 billion. Renewable energy has come of age in Germany, and "it's time for the system of subsidies to grow up too," a deputy parliamentary leader said. Read more [here](#).

U.S. Firm to Invest \$5.2 billion in German Grid. Massachusetts-based transmission project developer, Anbaric Transmission intends to invest \$5.2 billion in grid provider TenneT, which is largely responsible for connecting offshore wind parks to the German grid. Anbaric CEO Edward Krapels told German media/reporters that there have already been negotiations with TenneT, the German Government and the European Commission. Anbaric currently connects U.S. offshore wind farms to electricity grids in New York and New England. Read more [here](#)

German State Pledges \$1.3 Billion Toward Fighting Climate Change. Bavaria will spend more than \$1.28 billion on implementing climate protection and the country's planned nuclear energy phase-out. A four-point plan includes new policies, adaptations, research, and individual measures to address climate change. Read more [here](#).

ICELAND

Embassy Reykjavik Hosts Two Science Fellows This fall Embassy Reykjavik hosts Science Fellows James Gentry of the EPA and Anna Kerttula from the Arctic Social Sciences Program at NSF. Gentry assisted Keilir Institute of Technology (KIT) seeking U.S. funding and facilitated collaborative relationships with U.S. universities and small businesses conducting research in renewable energy. KIT is working to establish a Geothermal Resource Park and aspires to become a world leader in geothermal research. Gentry used the NSF's Industry/University Cooperative Research Centers to encourage the development of this project, and scheduled interactive webinars with EPA-funded institutions that are conducting research relevant for KIT. Kerttula worked on several arctic different initiatives and undertook public outreach in support of the Embassy's goals of highlighting U.S. research collaborations in Iceland and providing information about Arctic science and U.S. funding to Icelandic entities, MPs and government officials.

Geothermal Energy Conference to Take Place in Reykjavík

The Iceland Geothermal Energy Conference (IGC) 2013, hosted by the Iceland Geothermal initiative, will be focusing on the geothermal value chain. Conference topics include identifying the possibilities of geothermal; resource management; finance the role of governments, international funds and sustainable resource management and environmental issues related to geothermal energy. Read more [here](#). Visit the conference site [here](#). (Picture: www.geothermalconference.is)



NASA to Aid in Glacier Research NASA has brought their expertise to studying Icelandic glaciers, teaming up with Icelandic scientists. Scientists recently flew over Icelandic glaciers with a radar device observing the glaciers. Read more [here](#).

Iceland's Carbon Recycling International (CRI) Gets U.S. Patent, Signs Agreement on "Green" Production The patent relates to using CO₂ from geothermal plants to produce methanol. Additionally, CRI signed a deal to engage in the development of a Green Chemical Park, where output of one plant will become input of another. Read more [here](#), [here](#) and [here](#).

LATVIA

Environment Minister Urges U.S. Ambassador to Participate in Popularizing Latvia's Green Image On October 4th, the Latvian Minister for Environmental Protection and Regional Development, Edmunds Sprudz met with the newly-arrived U.S. Ambassador to Latvia, Mark

Pekala. Both discussed Latvian-American opportunities, defining and popularizing Latvia as the world's greenest country, and agreed that a clean environment and a green economy is a successfully-chosen path to Latvia's development. Read more [here](#)



U.S. Ambassador Pekala Highlights Opportunities for US-Latvian Trade. “Latvia has genius IT and computer scientists and we’re trying to connect this talent with the investors in Silicon Valley,” U.S. Ambassador Mark Pekala said during a presentation at the International School of Latvia. Ambassador Pekala also recognized Latvian ambitions to be a leader in green energy. Read more [here](#)

Seniors Master Computer Literacy in Latvia For the fourth consecutive year, Lattlecom, the largest electronic service provider in Latvia, is conducting its “Connect Latvia!” project with the ambition to teach 6000 seniors aged 50 and older basic computer and internet skills. The initiative received support from the Ministry of Welfare and the Ministry of Education and Science. Read more [here](#) (picture: www.baltic-course.com)

LITHUANIA

Lithuanians Send Nuclear Plant Back to Drawing Board

In an October 14 referendum, Lithuanians rejected a plan to build a nuclear plant to replace a Soviet-era facility closed under the terms of Lithuania's entry into the European Union. Read more [here](#) and [here](#). (picture: www.15min.lt)



Fuel Options for Greening Public Transport Compared

A recent assessment of fuels used in public transport in Kaunas found that buses powered with locally-produced biogas (and trolleybuses powered with electricity generated from natural gas) cause the least environmental damage for the city. Read more [here](#).

Lithuanian Engineers to Build Country's First Space Satellite. Young engineers currently intern at NASA's Ames Research Center to improve their skills and knowledge to help them build the nation's first space satellite. Read more [here](#).

NORWAY

Statoil Signs Cooperation Agreement with Rosneft. The two companies agreed to jointly explore offshore frontier areas of Russia and Norway and to conduct joint technical studies on two onshore Russian assets. The agreement also envisages Rosneft's acquisition of participating interests in selected Statoil projects. Read more [here](#).

Arctic Oil Gets New Research Center. The new center will deliver high-quality research of relevance to the oil industry in the Arctic. The center will be located in Tromsø and work closely with other institutions both in Norway and abroad. Read more [here](#).

U.S. DOE Grant for Norwegian Research in Energy Storage Technologies.

The U.S. Department of Energy has granted *Det Norske Veritas (DNV)* funding from the Advanced Research Projects Agency Energy (ARPA-E), for the development of breakthrough energy storage technologies. In cooperation with U.S.-based NexTech Materials and Beckett Energy Systems, the DNV-led project will identify where the limits of battery operations can be pushed to achieve greater performance. Read more [here](#)

Norway and India to Extend Partnership in Healthcare Sector. The two countries have decided to extend by five years their partnership in the healthcare sector after the success of their joint efforts in delivering child and maternal health services in select states under the National Rural Health Mission. Read more [here](#).

POLAND

Poland Moving to Feed-in Tariffs for Renewables. Poland, a country that produces 90% of its electricity with coal, announced that it will introduce a new law on renewable energy. The law will introduce feed-in tariffs for the first time and will likely take effect in early 2013. The announcement was made by Poland's deputy minister, Mieczyslaw Kasprzak, at a recent press conference. Read more [here](#).

The First Annual American Chamber of Commerce Innovation Conference Held October 2 in Warsaw. The conference brought together academic leaders and executives from companies such as GE, 3M, GM and Polish boiler equipment company Rafako to discuss ways to support each other in R&D and bringing ideas to the market place. The conference was a continuation of a dialogue started at the U.S.-Poland Business Summit this summer, in which participants explored internships and academic exchanges, technology transfer centers and public-private research projects. Read more [here](#).

Poland Joins the European Space Agency (ESA). In becoming the 20th member of ESA, Polish companies and research institutions will gain greater access to aerospace technologies and increase their competitiveness. Full membership in the ESA is an extension of an agreement Poland has had with the space agency since 2007, under which Poland has participated in a wide range of projects including weather tracking, earth observation and navigation. Read more [here](#).

U.S. Embassy Warsaw hosts Science Fellow from the Nuclear Regulatory Commission.

Eduardo Sastre from the Nuclear Regulatory Commission will be in Poland through December to work with officials from the Ministry of Economy's Energy Department, nuclear regulators, and academic institutions as Poland builds its civilian nuclear power program. Sastre will discuss the U.S. nuclear regulatory environment, facilitate training opportunities, build contacts between Polish and U.S. experts in the field and conduct public outreach on the U.S. experience with nuclear energy. Sastre will also travel to the Baltics to meet counterparts there.

RUSSIA

Environmentalists Criticize Gazprom Planning to Build Pipeline Through Altai “Golden Mountains” Government-owned Gazprom has planned a 1367 mile pipeline to supply Russian gas to China. The pipeline would cross 24.9 miles of the Ukok Plateau, a designated UNESCO World Heritage site. Greenpeace and other NGOs argue that the planned routing of the pipeline is illegal because it “severely violates the UNESCO international convention on world heritage.” Gazprom, however, claims that the pipeline is not illegal, citing recently passed legislation. The total cost of the pipeline is expected to be \$14 billion. Read more [here](#) and [here](#).

Russian Federation Chief Medical Officer Warns Against Smallpox Destruction. In October, Russian Federation Chief Medical Officer Dr. Gennady Onischenko elaborated on the need to preserve U.S. and Russian smallpox depositories, due to the threat of a resurgent as a result of terrorism. In addition to these two countries officially in possession of the virus, Dr. Onischenko claims that several illegal collections of the virus are stored elsewhere. Dr. Onischenko assured the media that Russian collections of dangerous virus are well protected. Read more [here](#). (In Russian)

Minister of Natural Resources and Environment Leads Inspection of Franz Josef Land Clean-up In September, Minister of Natural Resources and Environment Sergey Donskoy led a delegation to inspect legacy waste on the Franz Joseph archipelago in the most northern part of the Russian Arctic. President Vladimir Putin has put a major emphasis on Arctic clean-up and redevelopment of the Arctic between now and 2020. The Russian Arctic National Park administration is leading the clean-up efforts, with plans to dispose of 8,000 tons of waste from Alexandra and Hooker Island by the end of October. The goal is to have the entire region cleared by 2014. Read more [here](#). (In Russian)

Moscow Bank Dispenses Highly Radioactive Cash. Russian media reported on October 2nd that a Moscow retiree had received highly radioactive 5,000-ruble notes from her bank. The Emergency Situations Ministry determined that the radiation level of the bills was 8.2 Roentgen per hour, which is 20,000 times more than the average background radiation level. Authorities suspect that the radioactive banknotes had already been in circulation when the woman received them. Read more [here](#).

SWEDEN



Swedish Minister for IT and Energy and Ambassador Brzezinski Highlight New Cleantech Partnership Sweden's Minister for IT and Energy Anna-Karin Hatt and U.S. Ambassador Mark Brzezinski visited the Hammarby wastewater treatment plant in southern Stockholm to highlight a new partnership between the Swedish Environmental Research Institute and U.S. water technology company Xylem. Partners recently unveiled a

new R&D-center at the Hammarby plant that seeks to boost water-related environmental technology exports. Read more [here](#) (Picture: Minister Hatt and Ambassador Brzezinski. US Embassy)

Deputy Assistant Secretary Bay Fang in Stockholm; Addresses U.S. Climate

The Stockholm-based think tank FORCES hosted a seminar with DAS Fang on August 13. Fang zeroed in on recent reports showing that the U.S. has reduced greenhouse gas emissions by nearly eight percent since 2006. Fang also stressed the importance of international partnerships, lauding the work done by the Swedish American Green Alliance (SAGA.) SAGA was launched by Embassy Sweden and the Swedish Government in 2010. Read more [here](#)

Ambassadors Brzezinski and Oreck Walking the Talk on Clean Energy

On July 19, the U.S. Ambassador to Finland and current head of the League of Green Embassies, Bruce Oreck, visited Sweden. Ambassador Oreck was in Stockholm to review successes accomplished by U.S. Embassy Stockholm in lowering the Embassy's carbon footprint and observe how the Embassy is helping these U.S. cleantech companies partner in the Swedish marketplace. Read more [here](#). Additional information on the League of Green Embassies, read [here](#)



National Electric Vehicle Sweden (NEVS) Finalizes Acquisition of SAAB Automobile.

NEVS finalized its acquisition of the main assets of Saab in September. The acquisition included IP rights, the manufacturing plant and test laboratory facilities. Read more [here](#). (Picture: www.swedishamericangreenalliance.org)

EUROPEAN UNION

Environment Council of Cyprus Presidency Eyes Doha Climate Summit

On October 25th, the Environment Council adopted a set of common positions to enable the Cyprus Presidency and the European Commission to pursue an agreement for a second commitment under the Kyoto Protocol, during COP 18, in Doha, Qatar November– December, 2012. Read more [here](#).

EU Outlines its Policy for the Arctic. The European Commission and the EU High Representative for Foreign Affairs and Security Policy outlined the way forward for the EU's engagement in the Arctic. Summarized in three words, "knowledge, responsibility, engagement," the strategy contributes to research and sustainable development in the region and promotes environmentally friendly technologies for sustainable shipping and mining. Read more [here](#).

EU Activates New E-waste Recycling Rules. Under the new rules, EU member states will by 2016 be required to ensure that 45% of electrical and electronic equipment sold in each country is collected for recycling. That figure rises to 65% collection of all equipment sold by 2019, or an alternative measure of 85% of all waste electrical and electronic equipment (WEEE) generated in the country. Read more [here](#).

European Air Shortens Lives. According to the European Environmental Agency (EEA), dangerous levels of microscopic particles in the air, known as particulate matter, reduces human lives across the region by roughly eight months. European Commission-funded research showed that a reduction in particulate levels could extend life expectancy by 22 months in some areas. The EEA Executive Director stated that the pollution costs the EU \$1.3 trillion a year in healthcare and dealing with the impact on the ecosystems. Read more [here](#).

Energy Efficiency Directive Adopted. On October 4, the Council of the European Union endorsed the political agreement on the Energy Efficiency Directive. The aim is to help the EU attain its goal of 20% energy savings by 2020, thus saving nearly \$63 billion annually. The directive compels member states to develop three year plans for energy efficiency including measures such as renovation of public buildings, energy-saving programs for public services and energy audits for large companies. Read more [here](#).

Go-ahead for Limiting Sulfur Emissions from Ships. Sulfur pollution from ships will undergo further regulation in all seas of the European Union. The updated directive was definitively approved by the European Parliament on September 11. It has been estimated that air pollution from ships annually cause 50,000 premature in Europe. Read more [here](#).

UNITED STATES

We Can't Wait: Obama Administration Announces Seven Major Renewable Energy Infrastructure Projects that Would Power 1.5 million Home. President Obama announced that seven nationally and regionally significant solar and wind energy projects will be expedited. Together, these job-creating infrastructure projects would produce nearly 5,000 megawatts of clean energy, enough to power approximately 1.5 million homes, and support the President's all-of-the-above strategy to expand American made. Read more [here](#).

U.S. Sees Greatest Reduction in CO₂ Emissions. According to a recent report by the International Energy Agency, the U.S. has seen the greatest reduction in CO₂-emissions within the past six years in comparison to any other country, even as global CO₂-emissions have reached record highs. Read more [here](#).

DOI Sets Aside Millions of Acres for Solar Power. The Obama Administration announced its final plan for fast-tracking large-scale solar energy projects in a vast portion of the West, promising installations with enough wattage to power nearly 7 million homes over the next decade. The "All Of The Above" program, the nation's first comprehensive plan to develop solar power on public land, sets aside 285,000 acres that would have minimal impact on endangered wildlife and waters. Read more [here](#).

DOE Awards \$7M to Eight CCS Projects. DOE's \$7 million investment—leveraged with recipient cost-share to support approximately \$9.4 million in total projects—will support the development and deployment of Carbon Capture, Utilization, and Storage (CCUS) by focusing on

further improving the efficiency and reducing the costs associated with carbon capture. Read more [here](#).

USDA Announces New Biofuel Investments. As part of the strategy to enhance U.S. energy security, reduce America's reliance on imported oil and leverage domestic energy supply, while also supporting rural economies, the USDA and DOE announced a \$41 million investment in 13 projects that will drive more efficient biofuels production and feedstock improvements. Read more [here](#).

Solar Energy and Conservation Initiative Launched by U.S. Army. The U.S. Army has embarked on a new \$7 billion campaign to develop cutting-edge, utility-scale energy projects, with a modest focus on energy conservation and the use of alternative energy systems. The Army has been working with solar energy for some time, utilizing portable solar power units for soldiers in foreign countries. Read more [here](#).

The World's Most Powerful Climate Change Supercomputer Powers Up. The National Center for Atmospheric Research (NCAR) recently deployed one of the largest supercomputers in the world at its Wyoming Supercomputer Center in Cheyenne (WY). The 1.5 petaflop IBM-designed supercomputer, named "Yellowstone" is dedicated to studying anything from hurricanes and tornadoes to geomagnetic storms, tsunamis, wildfires, air pollution and the location of water beneath the earth's surface. "The Yellowstone supercomputer will dramatically advance our understandings of Earth," an NCAR spokesperson said. Read more [here](#).

131 Years of Global Warming in 26 Seconds. NASA has produced a 26-second animation depicting how temperatures around the globe have warmed since 1880; the year scientists call the beginning of the 'modern record'. The data comes from NASA's Goddard Institute for Space Studies in New York, which monitors global surface temperatures. Watch it [here](#).

NASA Goes Green. NASA has selected a team led by Ball Aerospace & Technologies Corporation for a technology demonstration of a high performance 'green' propellant alternative to the highly toxic fuel hydrazine. With this award, NASA opens a new era of innovative and non-toxic green fuels that are less harmful to the environment, have fewer operational hazards and decrease the complexity and cost of launch processing. Read more [here](#).

Drug Approved to Fight H.I.V. Infection. The Food and Drug Administration approved the first drug shown to reduce the risk of H.I.V. infection, a milestone in the 30-year battle against the virus that causes AIDS. The agency approved Truvada, a pill made by Gilead Sciences, as a preventive measure for people who are at high risk of acquiring H.I.V. through sexual activity, like those whose partners are infected. Read more [here](#).

Rapid H.I.V. Home Test Wins Federal Approval. After decades of controversy, the Food and Drug Administration has approved a new H.I.V. test that for the first time makes it possible for Americans to learn in the privacy of their homes whether they are infected. Read more [here](#). (Picture:



www.nytimes.com)

New York State Encouraging Big Renewables. Gov. Andrew Cuomo announced the NY-Sun Initiative, to help develop and fund a solar energy expansion plan. The goal is to double the amount of non-utility owned solar power installed annually in New York, and quadruple that amount by 2013. Read more [here](#).

Electric Car Maker Tesla Unveils Solar-powered Charging Stations to Promote Longer Trips. Tesla Motors Inc. unveiled six solar-powered charging stations, in California, that will help make refueling vehicles as fast as stopping for gas in a conventional car. Tesla plans to have more stations running throughout California and in parts of Nevada and Oregon by the end of the year, and expects to cover “almost the entire United States” within two years. Read more [here](#).

Kohl's Powers up Solar Initiative with 30 New Locations in 2012. Kohl's Department Stores will expand its solar program by nearly 25 percent in 2012, installing solar panels at approximately 30 additional Kohl's locations. While some of the new

solar sites will be in states such as California, Connecticut and Maryland where Kohl's already has a solar presence, additional sites will be located in new solar states for Kohl's, including Massachusetts, New York and Ohio. Read more [here](#).



Pilot accreditation program for Energy Efficiency and Renewable Energy Certificate Programs underway. The American National Standards Institute (ANSI), coordinator of the U.S. voluntary standardization system, and the Interstate Renewable Energy Council, Inc. (IREC) announced the four certificate-awarding entities that are currently participating in the ANSI-IREC pilot accreditation program for energy efficiency and renewable energy. Read more [here](#). (Picture: www.ansi.org)

Maine Deploys First U.S. Commercial, Grid-connected Tidal Energy Project. Leveraging a \$10 million investment from the DOE, Ocean Renewable Power Company (ORPC) will deploy its first commercial tidal energy device into Cobscook Bay. The project, which has supported more than 100 local and supply chain jobs, represents the first tidal energy project in the United States

with long-term contracts to sell electricity – helping to drive American leadership in this innovative clean energy technology and diversify the nation’s energy mix. Read more [here](#).

Denmark-based Insulation Manufacturer to Open a New Plant in Tennessee. Roxul Inc. is making its first move into the U.S. by opening a \$130 million plant that’s expected to bring 150 jobs and a major economic boost to the region. The firm is part of Denmark-based Rockwool International, the world’s leading producer of stone wool, a fiber-based insulation made from natural stone and recycled material. Read more [here](#).

EVENTS

UNFCCC Climate Change Conference, COP 18

Doha, Qatar. November 26– December 7, 2012

Arctic Frontiers: Geopolitics and Marine Production in a Changing Arctic

Tromsø, Norway. January 20 - January 25, 2013

Iceland Geothermal Conference

March 5-8, 2013 Reykjavik, Iceland

2013 Arctic Science Summit Week; The Arctic Hub-Regional and Global Perspectives

Krakow, Poland. April 14, 2013 – April 20, 2013

Arctic Council Ministerial meeting

Kiruna, Sweden. May 15, 2013

Energy Europe 2013

Copenhagen, Denmark. May 23, 2013 – May 25, 2013

FEATURED STORY

Carbon Capture and Sequestration (CCS)

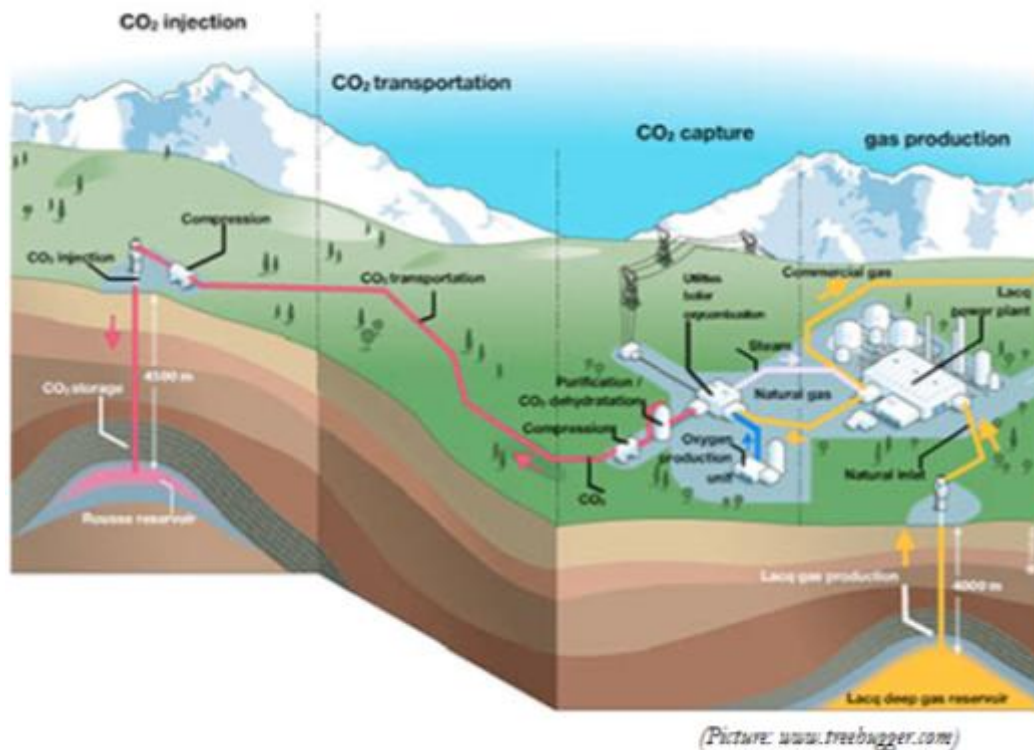
What is CCS?

Carbon Capture and Sequestration (CCS), also referred to as Carbon Capture and Storage, is the procedure of capturing CO₂ and permanently



(Picture: www.earthtimes.org)

storing it underground. The aim of CCS is to lessen the impact of CO₂ emissions on the climate. CCS is not the sole answer to the challenges of climate change, but may be needed to achieve a low-emission future.



Process

The first, and most costly, step in CCS is the capture of CO₂. This process is most effective when used at large CO₂ point sources such as power plants or industrial factories. Carbon

capture can be accomplished through post-combustion, pre-combustion or oxyfuel combustion technology. *Post combustion technology* typically uses amine solvents to absorb CO₂ from flue gas after combustion has taken place. *Pre-combustion* technology uses a series of reactions to remove CO₂ prior to combustion and uses the resulting hydrogen as a fuel source. *Oxy-fuel combustion* technology burns fuels in pure oxygen. The exhaust consists purely of CO₂ and water, which can be separated rather easily.

Once captured, the CO₂ can be moved in a number of ways, but often a pipeline will be the cheapest and most practical solution. A network of CO₂ pipelines, roughly 4,000 miles, already in the U.S. A study by the INGAA Foundation, a natural gas pipeline NGO, found that if CCS were to become commercially viable, the U.S. would need between 15,000 and 66,000 miles of pipeline by 2030.

Transport infrastructure is an important component of CCS, because capture sites are not always co-located with suitable sequestration reservoirs. Specific geological requirements include sufficient depth, a porous rock to hold CO₂ and a non-porous cap rock to ensure there is no leakage. CO₂ has been stored in depleted oil and gas fields, un-mineable coal seams and saline aquifers. Based on data collected for the DOE's Carbon Sequestration Atlas of the United States and Canada, enough capacity has been identified in the U.S. and Canada to store CO₂ for up to several hundred years.

Obstacles

There are many obstacles holding back the full commercialization of CCS. The largest issues stem from capital costs and lack of incentives. It is expensive both to build and run a plant with CCS, with modest financial benefits to be gained. However, CCS may benefit from Enhanced Oil Recovery (EOR) where CO₂ is pumped into oil fields to increase yields. This provides increased profits and therefore an incentive for CCS. The U.S. has a long history of successful EOR operations and the government is exploring further CCS/EOR potential.

At present, there is a broad scope of CCS demonstration plants in the U.S., but a full scale project has yet to be built. Several are in the planning stages. One such proposal, the DOE's FutureGen 2.0, is a plan to retrofit an Illinois coal-fired plant with oxyfuel combustion technology. If a full scale demonstration can be successfully achieved, it might lower the projected costs of CCS. In 2010, President Obama set a goal of bringing 5 to 10 commercial CCS operations online by 2016.

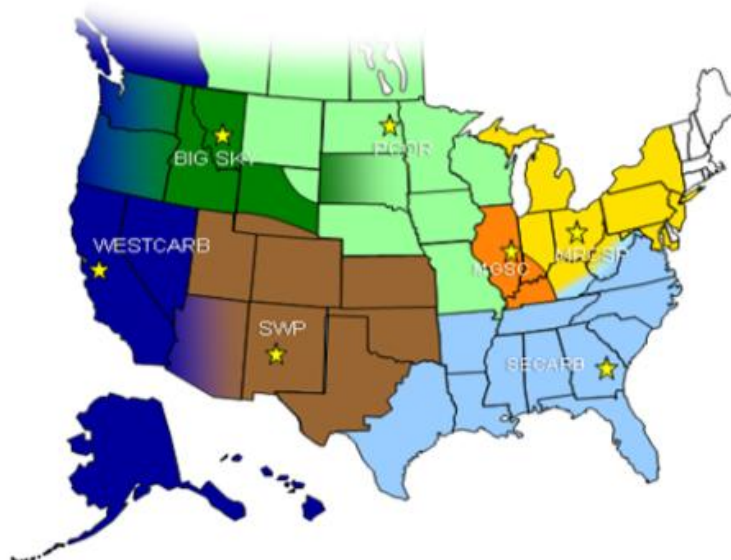
Controversy

There is considerable controversy surrounding CCS. Arguments center on whether CCS is really reducing the impact on the climate or simply prolonging the life of the fossil fuel industry. Renewable energy advocates argue that rather than spending R&D funds on CCS, funds should be allocated to further develop renewables. Proponents argue that CCS is necessary to control climate change, viewing EOR as a necessary jumpstart to the development and commercialization of CCS.

USG and CCS

Since 2008, Congress has appropriated nearly \$6 billion for CCS research, development and demonstration, including \$3.4 billion from the 2009 Recovery Act. A key piece of the USG CCS R&D plan are Regional Carbon Sequestration Partnerships (map). These 7 partnerships are collaborations between the government and

industry partners. They span both the U.S. and Canada and were created to help the development of technology, infrastructure and regulations for large scale CO₂ sequestration.



(Picture: www.fossil.energy.gov)

In an attempt to promote clean energy, the Environmental Protection Agency (EPA) recently proposed a set of standards for greenhouse gas emissions. The standards would force new power

plants to emit less than 1,000 pounds of CO₂ per megawatt hour produced. This standard is met by a modern gas powered plant; while new coal-fired plants would only meet the standards by using CCS.

CCS Development in the Nordic/Baltic region: Launched in May 2012, the Technology Centre Mongstad (TCM) in Norway is the world's largest facility for testing and improving CO₂ capture. TCM is a joint venture between the Norwegian state, Statoil, Shell and Sasol. Statoil's Sleipner project currently injects CO₂ into underground saltwater aquifers off the coast of Norway. In Poland, the Belchatów CCS project is under consideration for EU funding. Belchatów is one of top three contenders to be funded within the estimated USD 1.7-2.0 billion of European Commission funds available.

Further Reading

DOE info on CCS: http://www.netl.doe.gov/technologies/carbon_seq/index.html

IEA 2012 CCS policy strategy:

<http://www.iea.org/publications/freepublications/publication/name,20564,en.html>

DOE's Carbon Sequestration Atlas of the United States and Canada:

http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasIII/2010atlasIII.pdf

EPA on CCS with link to CCS Task Force Report 2010:

<http://www.epa.gov/climatechange/ccs/index.html#Federal>

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